
COPPER

Its Effect Upon

STEEL

for

ROOFING TIN



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STEEL

for

ROOFING TIN

A decorative flourish consisting of a black line that starts from the bottom left of the word 'ROOFING', loops around, and ends with a red-colored swirl.

American Sheet and Tin Plate Company

General Offices: Frick Building, Pittsburgh, Pa.

DISTRICT SALES OFFICES

Chicago Cincinnati Denver Detroit New Orleans New York Philadelphia Pittsburgh St. Louis

Export Representatives: United States Steel Products Company, New York City

Pacific Coast Representatives: United States Steel Products Company, San Francisco, Los Angeles, Portland, Seattle



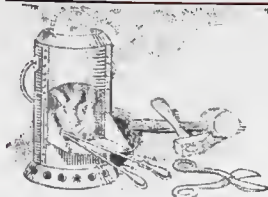
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(Revised)*

1916

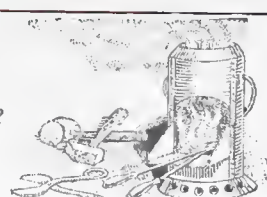


PRINCETON

Look for This Stamp—  *It Protects the User*



The Roof of *Quality* and *Service*
is made from



KEYSTONE COPPER STEEL

(Open Hearth)

ROOFING TIN

Terne Plate or Roofing Tin was subjected to criticism and disfavor as a roofing product, a number of years ago, primarily through the action of certain manufacturers and dealers, who, in their anxiety to meet competition, not only furnished material of an inferior quality, but misrepresented the amount of coating on various brands. These tactics, coupled with poor workmanship on the part of some tanners, naturally caused builders to look for other materials for roofing purposes, and the many cheap substitutes introduced from time to time have practically all been proved to be entirely unfit for permanent roofing. This resulted in the action of the American Sheet and Tin Plate Company, who, in order to protect the ultimate consumer, inaugurated the policy in 1906 of stamping all of its Roofing Tin with the weight of coating.

This Company also began experimenting with a view of supplying Metal Roofing superior to any which had been furnished in the past without materially increasing the cost. These experiments proved successful and announcement was made early in 1912 of the development of a product which would not only resist the acid test upon which much stress was then being laid; but which would also resist corrosion in actual service better than any iron or steel product on the market.

This material is known as *Keystone Copper Steel* and is furnished in either Black Sheets, Galvanized Sheets, Terne Plate or Tin Plate.

The conclusions were based upon actual tests with *uncoated* sheets upon roofs in several parts of the country. One of these was located in the Pennsylvania coke regions, where the air contains notable amounts of sulphurous and sulphuric acid and other fumes from the coke ovens. In this district, iron and steel, unless protected, corrode very fast. Another station was located on the sea coast, where the air carries sodium chloride. The third station was located in a rural district where the air is quite pure and free from added corrosive agents. At each of these stations a skeleton wooden building was erected, 40x80 feet, with a sloping roof at an angle of about 18 degrees with the low side about 6 feet from the ground. The buildings were entirely open and free to the passage of air on all four sides, and the roofs were uncovered until the sheets were put on. The sheets were arranged in panels, the grades being separated from each other by an open space. Open spaces were also left between each *course* so that the drip from one row did not run onto the row below.

As previously stated, all of the sheets were entirely unprotected by paint or

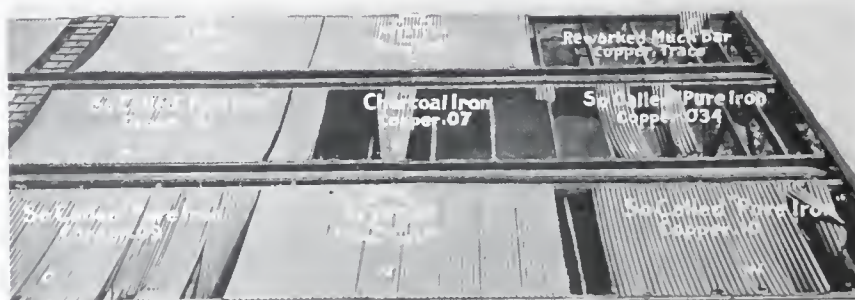
This Stamp——on Every Plate

other coating, which allowed natural corrosion to start immediately and to proceed without interruption. In conducting these tests, both regular Bessemer and Open Hearth Steel, with and without Copper, were used; also sheets of the so-called "pure irons" which were purchased in the open market, and which, by the way, *analyzed about .07 copper.*

In order to avoid the possible uncertainty in comparing different heats of steel with and without copper and in order that the conditions, except the copper content, should be identical, it was decided for these comparisons to copperize

trations of such tests. Numerous other tests have been conducted—all with similar results.

The question has been asked as to whether or not the presence of copper in steel would set up galvanic action. This would happen, no doubt, if copper came in mechanical contact with steel, but it is *most decidedly untrue* when the two metals form an alloy, as in the case of Keystone Copper Steel. In other words, the two metals are not present as copper and steel, but in the form of a perfect alloy.



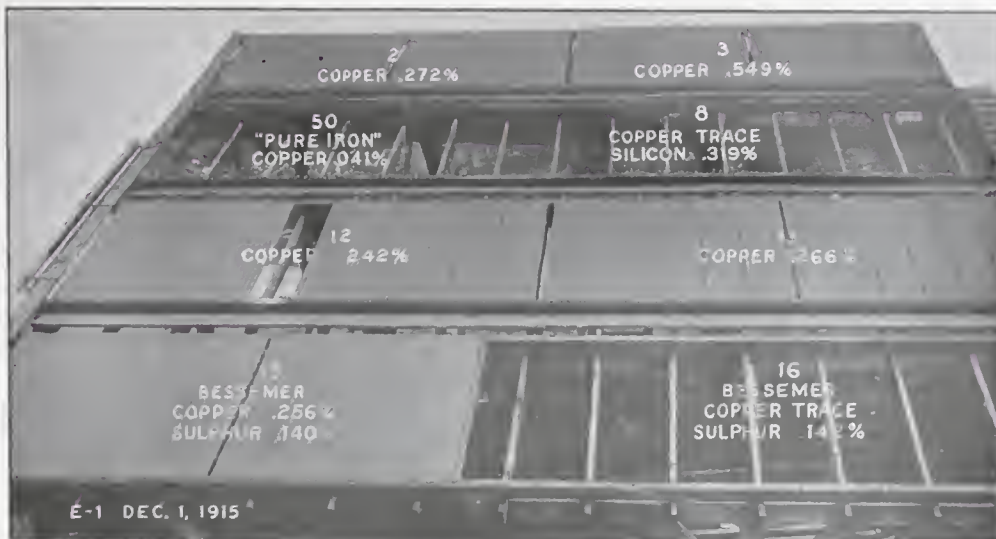
This picture of the out-in-the-weather test roof, covered with uncoated black sheets, tells the whole story. The superiority of Keystone Copper Steel is clearly evidenced. The same advantage is shown in all of the other test roofs.

portions of heats, leaving other portions of the same heat in their original condition. It will thus be seen that the tests were conducted fairly and that every element of doubt in so far as this was possible, was eliminated.

The results obtained from these investigations verified previous experiments along the same line, and proved conclusively that properly made steel containing from .15 to .25 per cent copper will resist corrosion from one and one-half to two times as well as the same steel without copper, and that it is also superior to the so-called "irons"—even though the latter contain a perceptible amount of copper. These results can perhaps best be appreciated by a glance at the illus-

After establishing the foregoing facts, the American Sheet and Tin Plate Company decided to use Open Hearth Keystone Copper steel exclusively in the manufacture of its Terne Plate for roofing purposes.

It is of interest to note that following the former extensive and thorough service tests of this Company, D. M. Buck, Metallurgical Engineer for the Company, and J. O. Handy, Director of the Pittsburgh Testing Laboratories, made still further investigations and tests of a very comprehensive character, embracing the various grades of iron and steel on the market as ordinarily used for roofing purposes. The results of these additional tests and scientific investigations are over-

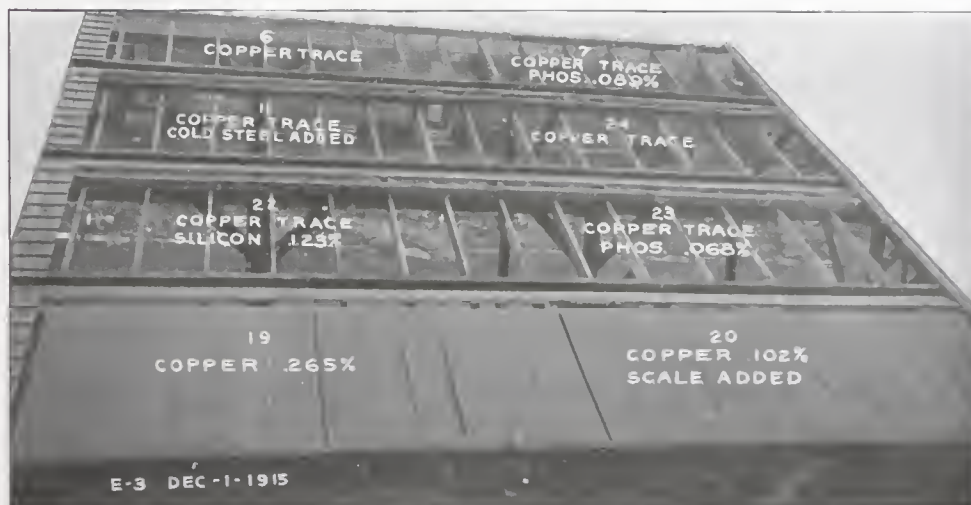
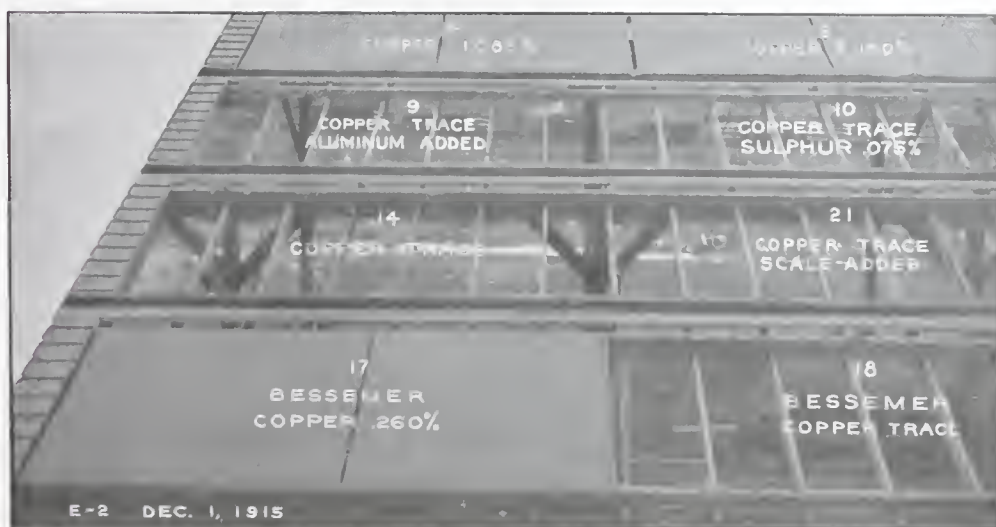


Results of Service Test
at Scottsdale, Pa.,
after about 1 1/2 year's
exposure.

Roof covered with
uncoated black
sheets.

Note the superior rust-
resistance of Copper
Steel, containing the
proper percentage
of copper

Arguments are
superfluous with
results like these



This Stamp— *on Every Plate*

whelmingly in favor of copper steel for roofing purposes, and for all other uses requiring the highest degree of resistance to corrosion resulting from exposure to the action of the elements. This is further corroborated by other scientific investigators.

In Messrs. Buck and Handy's treatise entitled "Research on the Corrosion Resistance of Copper Steel," published in the Journal of Industrial and Engineering Chemistry by the American Chemical Society, in March, 1916, the following definite results have been established for copper steel:

"Copper increases the resistance of steel and iron to atmospheric corrosion.

"The most effective amount of copper to be used for this purpose is approximately .25 per cent. Smaller amounts of copper down to as little as .04 per cent have considerable influence in lessening corrosion, but the results are not so good as with the higher amounts mentioned above.

"Steel containing .25 per cent copper outlasts 'pure iron' containing .05 per cent of the same; and steel containing .05 per cent copper is equally lasting to 'pure iron' containing a similar quantity.

"Sulphur accelerates corrosion very markedly, as do sulphur oxides in the air. Copper in steel counteracts or retards both corroding influences."

Similar results obtained by other scientific authorities, together with the large number of tests conducted by buyers and users, have demonstrated beyond question or argument that an alloy of copper and steel is the most durable base metal that can be used for roofing tin plates. This fact is conceded by every well-informed buyer and user of sheet metal roofing materials.

Highest Quality Standards Maintained

Terne Plate, or Roofing Tin, is a product made by coating steel or iron sheets with a mixture consisting of approxi-

mately 25 per cent Tin and 75 per cent Lead. Sheets coated in this manner by experienced workmen have been known to last over fifty years and can therefore be said to be the most durable roofing product on the market.

We now make a specialty of Terne Plate for roofing purposes, and are prepared to supply Keystone Copper Steel Open Hearth Roofing Tin, not only in our own brands, but are prepared to meet the requirements of jobbers whose private brands often necessitate unusual and careful attention in their manufacture.

The assertion from some quarters that "we cannot get good roofing tin any more" is not a fact. **THE SAME GOOD QUALITY PLATES ARE STILL MADE;** but the prevailing tendency to lessen cost by using cheaper grades, and labor, thereby sacrificing the old time quality, has been responsible for unsatisfactory results, and many erroneous statements. It is not to be expected that very light coated ternes will give the service of the old 30 and 40 pound grades. Give the tin roof a fair chance, by using good material and workmanship to start with. The results will not be disappointing.

While there have been many forms of roofings exploited in recent years, some of them with extravagant claims of superiority, it has remained for the good old-fashioned tin roof to demonstrate its superior worth and advantages by giving good and satisfactory service right on the building.

Much has been said to prejudice the minds of builders and property owners against tin as a roofing. Some of this perhaps has been warranted, for it is probably true that inferior material is found on the market which is called "roofing tin." However, only true worth is counterfeited, and the value of a good tin roof is in nowise affected by faulty and worth-

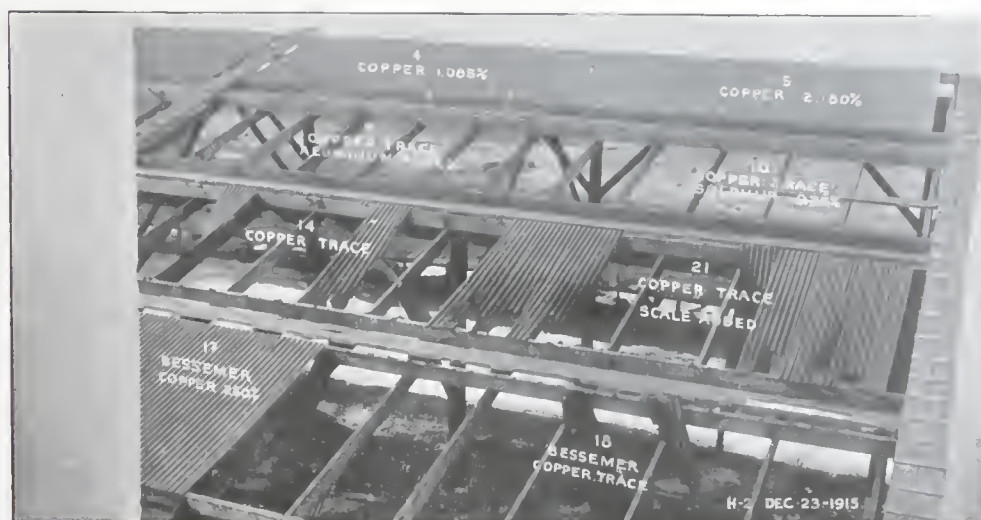


Another Weather Test Roof at McKeesport, Pa., showing condition at close of about 1½ year's exposure.

Roof covered with uncoated black sheets

"Pure Iron" panel No. 50 showing signs of failure. Copper Steel alone stood the test of time and weather

The amount of copper required to give best results is about .25



This Stamp— *on Every Plate*

less substitutes. The real truth is: the tin roof is coming more and more into favor and demand, and it is clearly the roofing of the future.

The first mission of a roof is protection—absolute and lasting; all its other features and advantages are secondary. The tin roof meets this first requirement perfectly. We have instances where roofs made of good roofing tin have lasted for over fifty years, and their service and protection has been faultless.

Advantages of Tin Roofing

The advantages secured by using high quality Terne Plates are many—more in fact than are found in any other roofing material. Tin Roofing embraces so many features of practical worth that it easily commands its place at the head of the list of all modern roofings. We mention but a few of the most important, but there are yet many other qualities of value that will appear to the user only as the years wear over his head:

COST—All things considered, the tin roof is most reasonable in cost. The best of terne plate can be obtained in any quarter at a very moderate price, and when the savings accruing from its use are considered, the item of first cost would be still further reduced.

SERVICE—The tin roof gives good service and will last indefinitely. It is impervious to all ravages of the elements, and is practicable in every climate. Those good old Southern homes—palatial monuments of comfort and stability, are roofed with tin, and its good service has never been questioned.

MAINTENANCE—The cost for maintenance is the minimum. The old threadbare complaint—"it has to be painted" is a misleading objection. Of course it has to be painted. So does wood work and finish. The saving in fire

insurance alone will often more than cover this very nominal expense—in fact the only attention required by this, the best of roofs.

REPAIRS—The tin roof does not require endless repairs, but in case of accident or damage to the roof it can be repaired in any kind of weather and at small expense.

FIREPROOF—This is an important feature. *A committee appointed from the Wisconsin State Legislature reported that 6 per cent or more of the fires in the United States for the year 1910 were roof fires.* When converted into money, this represented between \$13,000,000 and \$20,000,000. The tin roof is an effective "blanket policy" in case of fire.

LIGHTNINGPROOF—Protection from this source of frequent loss and damage means much to builders and owners of property in rural districts or communities removed from fire protection. We have no authentic instance of serious damage by lightning to buildings covered with tin roofs.

WEATHERPROOF—Extremes of weather do not affect the tin roof. The sudden deluge, melting snow, or cracking, bulging ice, which is disastrous to many high priced roofings, can do no damage to the tin roof. The continuous, unbroken surface of good terne plate practically seals the top of the building against every condition of weather.

LIGHTNESS—Heavy roofings frequently cause buildings to settle, crack the plaster and ruin interior finish and decorations. With a tin roof, lighter and less expensive structural work may be used, and still have a better roof.

ADAPTABILITY—In its various forms, the tin roof is adapted to all forms and pitches of roofs; and it can be readily applied to irregular surfaces and otherwise difficult roofing propositions.

All Primes—No Wasters

APPLICATION—The tin roof is easy to apply. The practical tinner is everywhere and his services are always available at a very reasonable figure. This is a decided advantage in case of accidents to the roof, alterations or repairs.

APPEARANCE—The tin roof always presents a neat and finished appearance. Particularly is this true of a standing seam roof, and when the ridge is finished with some simple sheet metal design, the roof is very attractive.

SANITARY AND CLEAN—This is important where water from the roof is run into cisterns. The tin roof is eminently clean and sanitary.

NOT EASILY DAMAGED—The presence of linemen or firemen upon the roof does not work untold injury and damage, with endless repair bills. The tin roof will withstand a great deal of punishment without serious damage.

OTHER ADVANTAGES—In addition to the foregoing, when we consider its many other advantages in that it does not crack, warp, split, run, clog gutters, blow off, nor develop any of the annoying traits of many modern roofings, we believe the tin roof is unquestionably the best obtainable.



Five city blocks of Keystone Copper Steel
tin roofs, Brooklyn, N. Y.

as Used for Sheet and Tin Mill Products



The Manufacture of Roofing Tin or Terne Plate

The material known as Roofing Tin or Terne Plate is composed of three metals—steel or iron, tin, and lead—hence the name "Terne Plate."

The greatest source of iron in this country is in the Lake Superior region, where the ore lies in vast bodies, underneath a relatively thin layer of earth.



1—Ore mine in Lake Superior region.
2—Great Lakes ore steamer.
3—Ore piles at blast furnace.
4—Blast furnace, where ore is reduced to pig iron.

Practically all the tin used in this country comes from the Far East, where it is mined, smelted, and refined, it being imported in the form of pig tin. Lead is mined, smelted, and refined most largely in our Western States, and reaches the user in the form of pig lead.



1—Open Hearth Furnaces.
2—Running the heat into ladle: Copper is added in ladle.
3—Casting the molten steel into ingots.

The method of mining is usually to remove the earth and then to load the ore by means of steam shovels directly from its bed into railroad cars, these being borne by rails leading onto the piers in the upper lake ports. Large fleets of steamers of large cargo capacity are con-

This Stamp— *on Every Plate*

tinuously in service, during the ice-free season of the lakes, transporting ore to the lower lake ports for immediate consumption and for winter stock. These steamers are loaded and unloaded with remark-

is done in the open hearth furnace, into which is charged the raw material on one side, and from which, on the other, the refined steel is tapped into the ladle. Here the steel receives the copper, thus gaining that property of superior resistance to the corrosive influences of the atmosphere, that characterizes Keystone Copper Steel (Open Hearth) Terne Plate. After thorough diffusion of the added material, the homogeneous steel is teemed into molds, in which the steel solidifies in ingot form.



1—Blooming Mill and roll train; reducing ingot to bars.
2—Pile of Tin Plate bars.
3—Cutting the bars. Subsequent rolling is across the short bars, and not lengthwise as might be supposed.

able celerity by means of huge, ingenious mechanical devices.

With coke, made from special coal, mostly mined in the famous Connellsville region, and with limestone as a flux, the ore is smelted in a blast furnace, the metal thus produced being in the form of pig iron.

In this condition, iron is not malleable, and must be especially refined to make it suitable for the basis of Keystone Copper Steel (Open Hearth) Terne Plate. This



1—Hot Rolling. Two sheets are placed together, and doubled and redoubled, and heated and reheated, during the process of reducing the bars to the desired gauge.
2—Reheating Furnace. 3—Shearing. 4—Opening the pack.

The ingot, after having the mold stripped from it, and having been brought to the proper rolling temperature throughout, in a furnace known as

Good Workmanship—Fine Finish

a "soaking pit," is reduced in cross section and increased in length by rolling, in the blooming mill. After having been cut to proper lengths, the billets, as they are then known, are carried by the roll

rolled together. During the process of hot rolling to the desired gauge, the sheets are doubled and redoubled, and heated, and reheated to restore the proper working temperature, the entire sequence of operation being carried on with due regard for every feature that goes to make the excellence of the finished product—Keystone Copper Steel (Open Hearth) Terne Plate.

The pack of several sheets is sheared with proper allowance for subsequent operations, including resquaring, later, to



1—The Pickler. 2—Annealing Furnace.
3—Cold Rolling the plates.
4—Resquaring. 5—Washing the Plates.

train to the bar mills in which the steel is reduced to the proper thickness, the resulting bars being about eight inches wide. These are cut into lengths corresponding to the width of the sheets to be rolled.

At the rolling mill, the bars are heated in lots in a furnace, whence they are withdrawn in pairs, to be rolled in the hot mill. Each bar is rolled sidewise until its thickness is reduced sufficiently, when they are matched, and afterwards are



1—Hand Dipping the plates into the molten terne mixture.
2—Mechanically cleaning the plates.
3—Inspecting and assorting

the finished size, and then it is opened, the several sheets being separated.

Steel oxidizes readily at high temperatures, and hot rolling strains the steel.

This Stamp—  *on Every Plate*

Hence the sheets after being freed from mill oxide by pickling in a dilute solution of sulphuric acid, are thoroughly washed and carefully annealed under cover.

That the coating may be smooth, the sheets are polished by cold rolling, the surfaces of the rolls being of a very high finish, and then, so that the roofer may lay his roof true, the sheets are accurately resquared.

To remove the slight strains of cold rolling, the sheets are again annealed under cover, and to prepare the sheets finally, for receiving their coating, they

are again pickled, this time much more lightly, and thoroughly washed.

The sheets are coated in a molten bath of tin and lead, the heavier coatings being obtained by redipping by hand, especial care being taken to obtain, by proper distribution of the alloy and its thorough alloying with the base, that reinforced resistance to corrosion that has given Keystone Copper Steel (Open Hearth) Terne Plate its well-deserved high reputation.

The Terne Plate is then carefully cleaned and inspected, and each perfect sheet impressed with the "stamp of quality"—*Keystone Copper Steel*.



Center Illustration—Stamping the plates
"KEYSTONE COPPER STEEL"

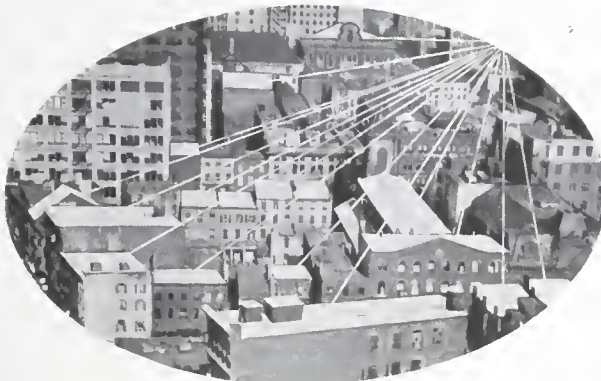
High Quality—Long Service



Home for Aged Women, Boston, Mass.—This MF Roof has given over 40 years' service



School Building at Jersey City, N. J. Roofed with MF over 15 years ago



View of down town section of New York showing the use of tin roofing for fire protection



This building was covered with flat seam MF Roofing 25 years ago



One of our tin roofs which has given 35 years' service



Residence covered with MF which has given 46 years' splendid service

This Stamp —  — on Every Plate

High Quality Roofing Tin Plates

Manufactured with a Base of KEYSTONE COPPER STEEL



MF ROOFING TIN

Consists of the base metal, the important properties, and is the only roofing tin for the best shipping. This is the MF Plate. MF is the first quality roofing tin manufactured, and has been made since 1882.

U. S. EAGLE ROOFING TIN

Consists of the base metal, the important properties, and is the only roofing tin for the best shipping. This is the U. S. Eagle Plate. U. S. is the first quality roofing tin manufactured, and has been made since 1882.

AMERICAN OLD STYLE ROOFING TIN

American Old Style AAAA	32 Pounds Coating	American Copper Steel
American Old Style AAAA	32 Pounds Coating	American Copper Steel
American Old Style AAA	32 Pounds Coating	American Copper Steel
American Old Style AA	32 Pounds Coating	American Copper Steel
American Old Style A	32 Pounds Coating	American Copper Steel

AMERICAN NEW METHOD ROOFING TIN

American New Method B	32 Pounds Coating	American Copper Steel
American New Method A	32 Pounds Coating	American Copper Steel
American New Method A	32 Pounds Coating	American Copper Steel

AMERICAN ROOFING TIN

American Roofing B	32 Pounds Coating	American Copper Steel
American Roofing A	32 Pounds Coating	American Copper Steel
American Roofing A	32 Pounds Coating	American Copper Steel

FIRE DOOR STOCK

32 Pounds Coating, carefully manufactured to meet the highest requirements. This product will be found satisfactory for all fire door purposes.

LONG IRON SHEETS

These sheets, when rolled in or Keene's Hot, are manufactured from high quality rolled in iron, and are of uniform quality, and are of uniform quality. Made in Georgia, to be of the best quality, and are of uniform quality. We make this grade of sheet in all lengths, 36, 42, and 48 inches, and in all widths, 36, 42, and 48 inches.

American Long Sheet AA	32 Pounds Coating
American Long Sheet A	32 Pounds Coating
American Long Sheet A	32 Pounds Coating
American Long Sheet A	32 Pounds Coating
American Long Sheet A	32 Pounds Coating

All Grades—8 to 40 lbs. Coating

Keystone Copper Steel

(Open Hearth)

ROOFING TIN

Is also furnished to meet the individual requirements of sheet metal jobbers who have their own private brands. It is to your interest however, to see that your plates are distinctly stamped

“KEYSTONE COPPER STEEL”

thus—



*Keystone Copper Steel Roofing Tin was awarded the Grand Prize (highest award)
at the Panama Pacific International Exposition, San Francisco,
for General Excellence and Greatest Merit.*

Specification for Tin Roofing Work

ALL ROOFING TIN used on this building shall be _____ brand, made on a base of KEYSTONE COPPER STEEL (Open Hearth), and stamped "Keystone Copper Steel" _____ * pounds coating. No substitute will be allowed. Use IC thickness for the roof proper, decks, etc., and IX thickness for valleys, gutters and spouts, as required by design. One coat of red lead, iron oxide, metallic brown or Venetian red paint, with pure linseed oil, shall be applied to the under side of the tin before laying.

FOR FLAT SEAM ROOFING, edges of sheets shall be turned one-half inch; all seams shall be well locked and well soaked with solder. Sheets to be fastened to the sheathing-boards by cleats spaced eight inches apart, cleats locked into the seams and fastened to the roof with two one-inch barbed wire nails; no nails to be driven through the sheets.

FOR STANDING SEAM ROOFING, sheets shall be put together in long lengths in the shop, cross seams to be well locked and well soaked with solder; sheets to be made up the narrow way in the rolls and fastened to the sheathing-boards by cleats spaced one foot apart.

VALLEYS AND GUTTERS shall be formed with flat seams well soldered, sheets to be laid the narrow way. Gutters to be laid so that, when finished, there shall be sufficient pitch to prevent any water standing therein.

FLASHINGS shall be let into the joints of the brick or stonework, and cemented. If counter-flashings are used, the lower edge of the counter-part shall be kept at least three inches above the roof.

SOLDER shall be of the best grade, bearing the manufacturer's name, and guaranteed one-half tin and one-half lead—new metals. Use rosin only as a flux.

CAUTION: No unnecessary walking over the tin roof, or using same for storage of material, shall be allowed. In walking on the tin, care must be taken not to damage the paint nor break the coating of the tin. Rubber-soled shoes or overshoes should be worn by the men on the roof.

PAINTING TIN WORK: All painting of the tin work shall be done by the roofer, using red lead, iron oxide, metallic brown or Venetian red paint, with pure linseed oil—no patent dryer or turpentine to be used.

All paints shall be applied with a hand-brush and well rubbed on. Tin shall be painted immediately after laying. A second coat shall be applied in a similar manner, two weeks later.

No deviation from these specifications shall be made unless authority is given in writing by the architect. Only a first-class roof will be accepted.

*The pounds coating desired must be inserted. This is important. Plates carrying less than 20 pounds should not be used for permanent buildings; 30 to 40 pounds coating is recommended. These plates are manufactured with standard amounts of coating used by the trade, 40-lb., 35, 32 (MF), 30, 25, 20, 15, 12 and 8-lb.

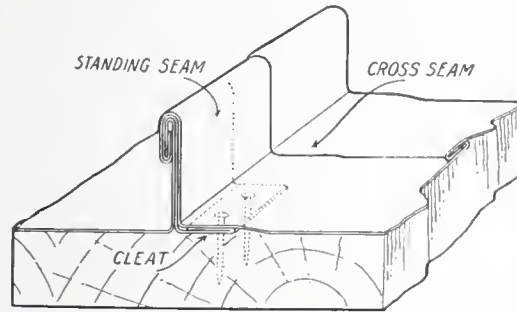
All brands of Roofing Tin made on this "Keystone Copper Steel" (Open Hearth) base are distinctly stamped "Keystone Copper Steel" in addition to the brand. Most of the jobbers' private brands are also stamped with the weight of coating. It is, therefore, an easy matter to tell at a glance whether or not the grade of plate specified is being used.

Construction Notes

SHEATHING—Sheathing of good, well seasoned dry lumber such as white pine or spruce, narrow widths, free from resinous knots and holes, and of even thickness should be used. Boards should be laid with tight joints.

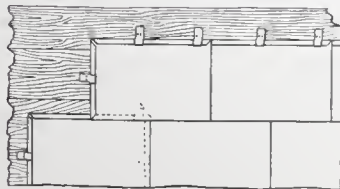
SHEATHING PAPER—There is a difference of opinion as to whether or not *sheathing paper* is to be recommended; but when the sheathing boards are as specified above, it is hardly necessary. However, if *sheathing paper* is used, it should be waterproof; no tar-paper or papers containing any trace of acid should be used.

STANDING SEAM ROOF—The roof should have an incline of not less than 2" per foot, preferably 4" to 6" per foot. Sheets 20" x 28" are used. Standing seams are finished approximately 1" high. A well constructed roof with standing seams presents a very attractive appearance.

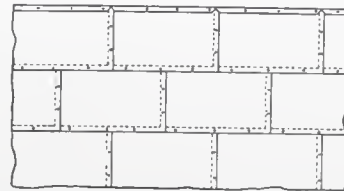


Method of laying Standing Seam

FLAT SEAM ROOF—The roof should have an incline of not less than $\frac{1}{2}$ " per foot over the entire surface. Sheets 14" x 20" should be used, as the larger number of seams stiffens the surface and helps prevent buckles. This specification calls for the use of cleats. The work is often done by driving 1-inch barbed and *tinned* roofing nails well under the edges of the seam so as to be entirely covered by the tin, as shown below. The nails should be approximately 6" apart. If the tin is carefully laid in this



Method of laying with cleats



Method of laying with nails driven through sheets

way, it will give good results. However, the use of cleats is preferable. By the use of cleats the roofing tin plates are held firmly in place, and at the same time there is enough elasticity to take care of the small amount of contraction and expansion in extreme weather, lessening the chances of straining the seams. These cleats are strips of the roofing tin, 1" x 2".

The Construction of Tin Roofs

Roofs with less than one-third pitch are made with flat seams, and should preferably be covered with high grade ternes, 20 pounds coating or heavier, from sheets 14x20 inches dimension rather than from sheets 20x28 inches, because the larger number of seams stiffens the surface and helps to prevent buckles and rattling in stormy weather. For flat seam roof, standard specifications require use of cleats. However, some roofers use 1-inch barbed and tinned roofing nails, driven 6 inches apart, well under the edge. They should be well covered up and the seams should be pounded down over the edge. Nails must never be exposed.

Steep tin roofs should be made with standing seams, and from sheets 20x28 inches, fastened down with cleats, not over 18 inches apart. The nails should be driven into the cleats only.

While it is always cheapest to use the best material, roofing plates with a lesser coating may be used for steep standing seam roofs. 1C roofing plates, in which the base plate weighs about 50 pounds per 100 square feet, are more suitable than 1X plates, 62 pounds per 100 square feet, because the seams in the lighter plates will not suffer as much from contraction and expansion as will the heavier plates.

For spouts, valleys and gutters, heavily coated 1X plate should always be used.

The amount of terne coating on the lighter plates should in all cases be fully as heavy as on the heavier plates.

In late years the anxiety of some manufacturers to satisfy the demand of some users for cheap goods has been the cause of many inferior grades being introduced.

This latter class of material may suit for some purposes outside of roofing, or for roofs on temporary buildings, but for roofs that are expected to last, the "double dipped" plates should be used.

The use of acid in soldering seams in a tin roof is to be carefully avoided; acid coming in contact with the base metal on the cut edges and corners where the sheets are folded and seamed together will cause rusting. No other soldering flux but good rosin should be used.

Every roof should be carefully cleaned, and all rosin spots and detrimental substances should be removed as the tinner's work is being finished. Lumps of rosin left on the roof will melt in the sun, stick to the roof, cause blisters and prevent paint from adhering.

For valleys, spouts and gutters of a tin roof no other metal than terne plates should be used, because the galvanic action produced by different metals coming in contact with each other will cause disintegration under atmospheric influences.

The sheathing boards underlying the roofing tin should be put close together. The wood should be well seasoned, dry, and free from resinous knots. It may be advisable to cover the boards with good building paper before the tin is laid on.

When no paper is used the tin must in all cases be painted on the underside with good reliable oil paint before it is laid and fastened on the roof. The outside should receive two coats of paint as soon as roof is finished.

Roof Painting.

For sheet metal work and tin roofs, no better paint has been found than metallic

Neat Appearance—Reasonable Cost

brown, venetian red, or red oxide paint ground in pure linseed oil. These paints have been used from time immemorial, with eminently satisfactory results. Use only a good grade of paint, and apply with a short handled brush, rubbing the paint well in. Do not spread it out too

thin. Roofs and sheet metal work should be kept well painted, the intervals depending largely on climatic conditions. After the initial coats of red oxide, the roof may be painted any color or shade to conform to color scheme. This is an important advantage.

Tables Showing Number of Plates Required to Cover a Given Area

Flat Seam Tin Roofing.

Table showing number of 14" x 20" plates required to cover a given number of square feet with flat seam tin roofing. A sheet of 14" x 20", with $\frac{1}{2}$ " edged or folded, measures 13" x 19", or 247 square inches. In the table, a fractional part of a sheet is counted a full sheet. Each sheet covers $231\frac{1}{4}$ square inches.

No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required
100	63	330	206	560	349	790	492
110	69	340	212	570	355	800	499
120	75	350	218	580	362	810	505
130	81	360	225	590	368	820	511
140	88	370	231	600	374	830	517
150	94	380	237	610	380	840	524
160	100	390	243	620	387	850	530
170	106	400	250	630	393	860	536
180	113	410	256	640	399	870	542
190	119	420	262	650	405	880	548
200	125	430	268	660	411	890	555
210	131	440	274	670	418	900	561
220	137	450	281	680	424	910	567
230	144	460	287	690	430	920	573
240	150	470	293	700	436	930	580
250	156	480	299	710	443	940	586
260	162	490	306	720	449	950	592
270	169	500	312	730	455	960	598
280	175	510	318	740	461	970	605
290	181	520	324	750	468	980	611
300	187	530	331	760	474	990	617
310	194	540	337	770	480	—	—
320	200	550	343	780	486	—	—

1,000 square feet, 623 sheets.

A box of 112 sheets, 14 x 20 inches, will cover approximately 180 square feet.

Standing Seam Tin Roofing.

Table showing number of 20" x 28" plates required to cover a given number of square feet with standing seam tin roofing. Standing seams and locks on a steep roof require $2\frac{3}{4}$ " off the width, and 1" off the length of the sheet. A sheet after edging will measure $46\frac{5}{8}$ square inches. In the table, a fractional part is counted as a full sheet. Each sheet will cover $457\frac{1}{8}$ square inches.

No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required	No. of Sq. Ft.	Sheets Required
100	32	330	104	560	177	780	246
110	35	340	108	570	180	790	249
120	38	350	111	580	183	800	253
130	41	360	114	590	186	810	256
140	45	370	117	600	190	820	259
150	48	380	120	610	193	830	262
160	51	390	123	620	196	840	265
170	54	400	127	630	199	850	268
180	57	410	130	640	202	860	271
190	60	420	133	650	205	870	275
200	64	430	136	660	208	880	278
210	67	440	139	670	212	890	281
220	70	450	142	680	215	900	284
230	73	460	145	690	218	910	287
240	76	470	149	700	221	920	290
250	79	480	152	710	224	930	293
260	82	490	155	720	227	940	297
270	86	500	158	730	230	950	300
280	89	510	161	740	234	960	303
290	92	520	164	750	237	970	306
300	95	530	167	760	240	980	309
310	98	540	171	770	243	990	312
320	101	550	174	—	—	—	—

1,000 square feet, 316 sheets.

A full box, 112 sheets 20 x 28 inches, will cover approximately 356 square feet.

This Stamp—  *on Every Plate*

Cost of Tin for Flat Seam Roofing

Price per Box, per Square Foot and per 100 Square Feet

SIZE 14 x 20.				SIZE 20 x 28.			
When Tin Costs	Flat Seam Roofing Costs	Flat Seam Roofing Costs		When Tin Costs	Flat Seam Roofing Costs	Flat Seam Roofing Costs	
\$3.00 per box	14x20 .0167 per sq. ft. or	\$1.67 per sq.		\$6.00 per box	20x28 .0157 per sq. ft. or	\$1.57 per sq.	
3.25	.0181	1.81		6.50	.0171	1.71	
3.50	.0195	1.95		7.00	.0184	1.84	
3.75	.0208	2.08		7.50	.0197	1.97	
4.00	.0222	2.22		8.00	.0210	2.10	
4.25	.0236	2.36		8.50	.0223	2.23	
4.50	.0250	2.50		9.00	.0236	2.36	
4.75	.0264	2.64		9.50	.0249	2.49	
5.00	.0278	2.78		10.00	.0262	2.62	
5.25	.0292	2.92		10.50	.0275	2.75	
5.50	.0306	3.06		11.00	.0289	2.89	
5.75	.0320	3.20		11.50	.0302	3.02	
6.00	.0334	3.34		12.00	.0315	3.15	
6.25	.0347	3.47		12.50	.0328	3.28	
6.50	.0361	3.61		13.00	.0341	3.41	
6.75	.0375	3.75		13.50	.0354	3.54	
7.00	.0389	3.89		14.00	.0367	3.67	
7.25	.0403	4.03		14.50	.0380	3.80	
7.50	.0417	4.17		15.00	.0393	3.93	
7.75	.0431	4.31		15.50	.0407	4.07	
8.00	.0445	4.45		16.00	.0420	4.20	
8.25	.0459	4.59		16.50	.0433	4.33	
8.50	.0473	4.73		17.00	.0446	4.46	
8.75	.0486	4.86		17.50	.0459	4.59	
9.00	.0500	5.00		18.00	.0472	4.72	
9.25	.0514	5.14		18.50	.0485	4.85	
9.50	.0528	5.28		19.00	.0498	4.98	
9.75	.0542	5.42		19.50	.0511	5.11	
10.00	.0556	5.56		20.00	.0525	5.25	
10.25	.0570	5.70		20.50	.0538	5.38	
10.50	.0584	5.84		21.00	.0551	5.51	
10.75	.0598	5.98		21.50	.0564	5.64	
11.00	.0611	6.11		22.00	.0577	5.77	
11.25	.0625	6.25		22.50	.0590	5.90	
11.50	.0639	6.39		23.00	.0603	6.03	
11.75	.0653	6.53		23.50	.0617	6.17	
12.00	.0667	6.67		24.00	.0630	6.30	

NOTE—Above does not include cost of laying.



Recreation Pier New York, with MF Roof which had given 11 years excellent service under hard conditions, before photograph was taken

Soft—Pliable—Easily Worked

Cost of Tin for Standing Seam Roofing Price per Box, per Square Foot and per 100 Square Feet

SIZE 14x20.					SIZE 20 x 28.				
When Tin Costs	Standing Seam Roofing Costs			Standing Seam Roofing Costs	When Tin Costs	Standing Seam Roofing Costs			Standing Seam Roofing Costs
\$3.00 per box	14x20	.0185	per sq. ft. or	\$1.85 per sq.	\$6.00 per box	20x28	.0169	per sq. ft. or	\$1.69 per sq.
3.25	"	.0201	"	2.01	6.50	"	.0183	"	1.83
3.50	"	.0216	"	2.16	7.00	"	.0197	"	1.97
3.75	"	.0232	"	2.32	7.50	"	.0211	"	2.11
4.00	"	.0247	"	2.47	8.00	"	.0225	"	2.25
4.25	"	.0263	"	2.63	8.50	"	.0239	"	2.39
4.50	"	.0278	"	2.78	9.00	"	.0253	"	2.53
4.75	"	.0293	"	2.93	9.50	"	.0267	"	2.67
5.00	"	.0309	"	3.09	10.00	"	.0281	"	2.81
5.25	"	.0324	"	3.24	10.50	"	.0295	"	2.95
5.50	"	.0340	"	3.40	11.00	"	.0309	"	3.09
5.75	"	.0355	"	3.55	11.50	"	.0323	"	3.23
6.00	"	.0371	"	3.71	12.00	"	.0337	"	3.37
6.25	"	.0386	"	3.86	12.50	"	.0352	"	3.52
6.50	"	.0402	"	4.02	13.00	"	.0366	"	3.66
6.75	"	.0417	"	4.17	13.50	"	.0380	"	3.80
7.00	"	.0432	"	4.32	14.00	"	.0394	"	3.94
7.25	"	.0448	"	4.48	14.50	"	.0408	"	4.08
7.50	"	.0463	"	4.63	15.00	"	.0422	"	4.22
7.75	"	.0479	"	4.79	15.50	"	.0436	"	4.36
8.00	"	.0494	"	4.94	16.00	"	.0450	"	4.50
8.25	"	.0510	"	5.10	16.50	"	.0464	"	4.64
8.50	"	.0525	"	5.25	17.00	"	.0478	"	4.78
8.75	"	.0541	"	5.41	17.50	"	.0492	"	4.92
9.00	"	.0556	"	5.56	18.00	"	.0506	"	5.06
9.25	"	.0572	"	5.72	18.50	"	.0520	"	5.20
9.50	"	.0587	"	5.87	19.00	"	.0534	"	5.34
9.75	"	.0602	"	6.02	19.50	"	.0548	"	5.48
10.00	"	.0618	"	6.18	20.00	"	.0562	"	5.62
10.25	"	.0633	"	6.33	20.50	"	.0577	"	5.77
10.50	"	.0649	"	6.49	21.00	"	.0591	"	5.91
10.75	"	.0664	"	6.64	21.50	"	.0605	"	6.05
11.00	"	.0680	"	6.80	22.00	"	.0619	"	6.19
11.25	"	.0695	"	6.95	22.50	"	.0633	"	6.33
11.50	"	.0710	"	7.10	23.00	"	.0647	"	6.47
11.75	"	.0726	"	7.26	23.50	"	.0661	"	6.61
12.00	"	.0741	"	7.41	24.00	"	.0675	"	6.75

NOTE—Above does not include cost of laying.



Hotel Vendome, Boston, Mass. The sloping parts of roof were covered with MF, and after 18 years, the tin was found in excellent condition.

This Stamp— on Every Plate

Weights of Roofing Materials.

Table showing approximate weights per square foot of various materials used for roofing.

MATERIAL	Average Weight, Lbs. per Sq. Ft.
Corrugated Galvanized Sheets, No. 20, unboarded	2 1/4
Copper, 16 oz. standing seam	1 1/4
Felt and asphalt, without sheathing	2
Glass, 1/8 inch thick	2
Hemlock sheathing, 1 inch thick	2 1/4
Lath and plaster ceiling (ordinary)	6 to 8
Lead, about 1/8 inch thick	6 to 8
Mackite, 1 inch thick, with plaster	10
Neponset roofing, felt, 2 layers	1/2
Shingles, 6x18—one-third to weather	2
Skylight of glass, 3/16 to 1/2 inch, inc. frame	4 to 10
Slag roof, 4-ply	4
Slate, 1/8 inch thick, 3 inch double lap	4 1/2
Slate, 3/16 inch thick, double lap	6 3/4
Spruce sheathing, 1 inch thick	2 1/4
Terne plate, 1C, without sheathing	1/2 to 5/8
Terne plate, 1X, without sheathing	5/8 to 3/4
Tiles (plain) 10 1/2 x 6 1/4 x 5/8—5 1/4 in. to weather	18
Tiles (Spanish) 14 1/2 x 10 1/2—7 1/4 in. to weather	8 1/2
White pine sheathing, 1 inch thick	2 1/4
Yellow pine sheathing, 1 inch thick	3 1/2

Snow and Wind Loads.

SNOW LOAD—The snow loads on roofs vary with the geographical location, its altitude and humidity, and with the slope of the roof. Where snow is likely to occur, the minimum load per horizontal square foot of roof should be taken at 25 pounds for all slopes up to 20 degrees; this load to be reduced one pound for each degree of increase in slope up to 45 degrees, above which no snow load need be considered. In severe climates these loads should be increased in accordance with actual conditions. Regard should also be taken of the possibility of partial snow load with local concentration.

WIND LOAD—The wind is considered as blowing in a horizontal direction, but the resulting pressure upon the

roof is always taken *normal* (at right angles) to the slope. The wind pressure against a vertical plane depends on the velocity of the wind, and, as ascertained by the United States Signal Service at Mount Washington, N. H., is as follows:

Velocity (Miles per Hr.)	Pressure (Lbs. per Sq. Ft.)	
10	0.4	Fresh breeze
20	1.6	Stiff breeze
30	3.6	Strong wind
40	6.4	High wind
50	10.0	Storm
60	14.4	Violent storm
80	25.6	Hurricane
100	40.0	Violent hurricane

The wind pressure upon a cylindrical surface is one-half that upon a flat surface of the same height and width.

Since the wind is considered as traveling in a horizontal direction, it is evident that the more nearly vertical the slope of the roof, the greater will be the pressure. The following table gives the pressure exerted upon roofs of different slopes by wind pressure of 40 pounds per square foot on a vertical plane, which is equivalent in intensity to a violent hurricane.

Wind Pressures.

Rise in Inches per Foot of Run	Angle with Horizontal	Pitch Proportion of Rise to Span	Wind Pressure Normal to Slope (lbs. per sq. ft.)
4	18° 26'	1/10	16.8
6	26° 34'	1/8	23.7
8	33° 41'	1/6	29.1
12	45° 0'	1/2	36.1
16	53° 8'	2/3	38.7
18	56° 19'	1/1	39.3
24	63° 26'	1	40.0

COMBINED LOADS—In addition to the snow and wind loads, the weight of the roof covering and of the structural members should be included in the weight to be supported.



American Sheet and Tin Plate Company

Pittsburgh, Pa.

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